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| 09/708,159 | 11/08/2000 | Toshiaki Yasue | JP919990097US1 | 1032 |

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| EXAMINER |
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RUTTEN, JAMES D

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| ART UNIT | PAPER NUMBER |
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2192

DATE MAILED: 07/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/708,159

Applicant(s)

YASUE ET AL.

Examiner

J. Derek Rutten

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 22 April 2005 has been entered. Claims 1, 2, and 4 have been amended, no claims have been canceled, and new claims 5-10 have been added. Claims 1-10 remain pending in the application and have been fully considered by the examiner.

Response to Arguments

2. Applicant's arguments with respect to claims 1-10 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-10 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with

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which it is most nearly connected, to make and/or use the invention. The claims generally recite:

*“from an interpreter process to a **loop process** of a compiled code process”*, then continue to manipulate transfer points around the loop process. As known to those of ordinary skill in the art, the loop process of a compiled code process is interpreted to refer to the “main loop” of the program which repeats the principle function of the program until the program is terminated. All functions of a program occur within the main loop. However, the originally filed specification appears to be dealing with transfer points in a programmatic loop that are analyzed in the context of an abstract flow graph (e.g. page 10 line 2 “control flow graph”). The specification is silent on moving transfer points to relative positions around the main loop of a compiled code process. For the purpose of further examination, the “loop process” is interpreted to refer to a general loop found within a control flow graph.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 4, and 8-10 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential elements, such omission amounting to a gap between the elements. See MPEP § 2172.01. The omitted elements are: Elements of a program storage device readable by a machine, tangibly embodying a program of instructions executable by a machine to perform various method steps. While the preamble of the claims recite a “program storage device...”, the remainder of the claim does not provide supporting tangible elements which are necessary for such a program storage device to perform the invention (e.g. *computer executable instructions for moving...*, or *computer executable instructions for copying...*, etc.).

Claim Rejections - 35 USC § 101

7. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

8. Claims 1-3 and 5-7 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The language of the claims raises a question as to whether the claim is directed merely to an abstract idea that is not tied to a technological environment or machine which would result in a practical application producing a concrete, useful, and tangible result to form the basis of statutory subject matter under 35 U.S.C. 101. While directed to a statutory “process”, the claimed “program execution method” is not supported by any claim elements that would produce tangible results. The claims require the addition of tangible hardware elements to provide tangible results.

9. Claims 4 and 8-10 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claims are non-tangible since the body of the claims contain method steps that are an arrangement software and does not provide tangible results. The claims require the addition of tangible hardware implemented elements that would provide tangible results.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over prior art of record “Compilers: Principles, Techniques, and Tools” by Aho et al. (hereinafter “Aho”) in view of prior art of record U.S. Patent 6,513,156 to Bak et al. (hereinafter referred to as “Bak”), further in view of prior art of record “Compiler Transformations for High-Performance Computing” by Bacon et al. (hereinafter referred to as “Bacon”).

In regard to claim 1, Aho discloses:

A program execution method, comprising the steps of:

moving said one or more transfer points to the top of a loop process if they can be moved there without a problem occurring; Aho discloses that code containing loop invariant computations can be moved to the top of a loop without a problem occurring (pages 596 and 638-642). Further still, Aho gives an in-depth discussion of analysis of code containing transfer points on pages 653-660. This analysis would inform any optimizations involving loop invariant computations. While Aho does not expressly disclose moving transfer points to the top of a loop, this step would be obvious in any code that contains transfer points under analysis as a candidate for optimization as discussed on page 659: “*Use of Change Information*”, which discusses such analysis for the purpose of common subexpression identification. One of ordinary skill in the art would be motivated to determine the impact of a procedure on variables in a program in order to determine if the procedure could be optimized (page 655 paragraph 3).

copying code from the top of the loop process to a point that post-dominates said top of said loop process and said one or more transfer points to a location immediately preceding said loop process if said transfer points are located inside said loop process;

Aho discusses code optimizations that benefit from the reducibility of flow graphs containing loops in terms of using intervals, interval graphs, and node splitting (see pages 664-668). In particular, node splitting is a technique that is used to produce a limit flow graph of a single node (page 666, last paragraph). Additional nodes are created that precede the original node. Fig. 10.49 shows that node 2 is split into nodes 2a and 2b. When combined with node 1, node 2a now precedes the loop that is formed between nodes 2b and 3. Further description is found on pages 679-680, which describes duplicating a region that represents a node, and placing that region in a location preceding the node. This process is shown in Fig. 10.57 on page 680, which shows a copied node containing a transfer point that immediately precedes the loop process.

Aho further discloses common subexpression elimination (Fig. 10.7 on page 593), and code motion (page 596).

Aho does not expressly disclose: transferring a method from an interpreter process to a compiled code process; storing information for generating recalculation code for specific transfer points; performing a recalculation during a transfer process; or privatization.

However, in an analogous environment, Bak teaches: *transferring, from an interpreter process to a compiled code process, a method that is currently being executed for code that includes a plurality of transfer points at which program execution is*

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transferred from the interpreter process to the compiled code process. See column 2 lines 40-45:

the hybrid virtual and native machine instructions may be easily transformed back to the original virtual machine instructions, and the flexibility of compiling only certain portions of a function into native machine instructions allows for better optimization of the execution of the function.

storing information for generating recalculation code for one or more specific transfer points See column 2 line 65 – column 3 line 1:

A copy of a selected virtual machine instruction at a beginning of the portion of the function is **stored** and a back pointer to a location of the selected virtual machine instruction is also stored.

and performing a recalculation during a transfer process See column 3 lines 1-5:

The selected virtual machine instruction is overwritten with a new virtual machine **instruction that specifies execution** of the native machine instructions so that the function includes both virtual and native machine instructions.

Also in an analogous environment, Bacon teaches: *privatization* See page 395

Section 7.1.3:

When a scalar is used within a loop solely as a scratch variable, each processor can be given a private copy so the use of the scalar need not involve any communication.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bacon's optimizations with Bak's mixed mode interpreter in Aho's code optimizer. One of ordinary skill would have been motivated to improve object code, particularly code appearing in loops, so that a program will execute in less time. Further, one would have been motivated to transfer the execution of an interpreted loop to natively compiled instructions since native code executes more quickly than interpreted code.

As per claim 2, the above rejection of claim 1 is incorporated. Aho does not expressly disclose choosing transfer points for transferring from interpreted mode to compiled mode execution.

However, Bak teaches *defining as a new transfer point, a point from said interpreter process to said compiled code process whereat, when said method that is currently being executed is replaced, the execution speed is increased compared with when said method is not replaced* (column 6 line 61 – column 7 line 5).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak's selection of transfer points in O'Brien's code optimizer. One of ordinary skill would have been motivated to improve code so that a program will execute in less time.

As per claim 3, the above rejections of claims 1 and 2 are incorporated. Aho does not expressly disclose generating, storing, or employing information for transferring execution from interpreted to compiled execution.

However, Bak teaches:

generating information required to perform a transfer from said interpreter process to said compiled code process (column 7 lines 28-40); *and*

storing said generated information while correlating said generated information with said transfer points (column 7 lines 28-40 as cited above),

wherein, at said recalculation step, said information stored for said transfer points is employed (column 7 lines 63-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak's transfer information with O'Brien's code optimizer. One of ordinary skill would have been motivated to enable the transfer of interpreted execution to natively compiled execution, which is necessarily supported by information regarding the location of code, to increase the speed of a program.

As per claim 4, Aho does not expressly disclose a program storage device.

However, Bak teaches the use of a program storage device to hold program instructions (column 4 lines 46-50).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak's program storage device with O'Brien's code optimizer. One of ordinary skill would have been motivated to store copies of a program on media that enables the distribution of the program to colleagues or customers.

All further limitations have been addressed in the above rejection of claim 1.

In regard to claims 5-7, all limitations have been addressed in the above rejection of claim 1.

In regard to claims 8-10, all limitations have been addressed in the above rejection of claim 4.

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Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US 5862384 A to Hirai discloses moving a transfer point to the top of a loop in order to promote optimization. See Figures 11 and 12.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. Derek Rutten whose telephone number is (571) 272-3703. The examiner can normally be reached on T-F 6:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jdr

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PRIMARY EXAMINER
7/11/05